

The relationship between attention deficit hyperactivity disorder and child temperament [☆]

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Abstract

This study examined empirical and theoretical differences and similarities between attention deficit hyperactivity disorder (ADHD) and child temperament in 32 ADHD children aged 6–11 years, and a comparison group of 23 children with similar sociodemographic characteristics. Children were assessed for ADHD symptoms (hyperactivity, impulsivity, and inattention) and dimensions of child temperament (negative reactivity, task persistence, activity, attentional focusing, impulsivity, and inhibitory control) using standardized parent reports and interviews. Symptoms of ADHD and temperament dimensions were correlated; children in the ADHD group had significantly higher scores on negative reactivity, activity and impulsivity, and lower scores on task persistence, attentional focusing and inhibitory control than normative samples. Results indicate that although the constructs of ADHD and temperament have been regarded as two separate bodies of knowledge, theoretical and empirical overlaps exist. Applied implications are discussed.

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1. Introduction

ADHD is one of the most common behavioral disorders diagnosed in children and adolescents. Although prevalence varies among different communities and is dependent upon the criteria used for diagnosis, national estimates indicate that 3%–5% of school-age children have been diagnosed with ADHD (National Institutes of Health, 2000). The criteria for a diagnosis of this disorder include impairment within the areas of activity, attention, and impulsivity (American Psychiatric Association, 2000).

The same behaviors are regarded differently from a temperament perspective. Temperament theorists view children's temperaments as existing on a continuum that includes a wide range of normal variations (Cloninger, 1987;

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Rothbart & Bates, 1998). While children whose temperaments at the extreme end of the continuum are more arduous for parents and teachers to manage, their behavior is still considered normal.

Although the terminology used to diagnose ADHD is also used in the temperament literature (activity, impulsivity, inattention and low task persistence), few empirical investigations have examined these domains simultaneously. Instead, research in the fields of child temperament and child psychopathology, as related to attention deficit hyperactivity disorder, have been regarded as two separate bodies of knowledge. The purpose of this study was to examine the theoretical differences and similarities of child temperament and ADHD.

1.1. Attention deficit hyperactivity disorder (ADHD)

A diagnosis of ADHD in the US is based on the criteria cited in the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000)*. The subtypes are ADHD inattentive, ADHD hyperactive–impulsive, and ADHD combined. Inattention includes failing to pay close attention to details or making careless mistakes, having difficulty sustaining attention, not listening, not following through, having difficulty organizing, having low task persistence, losing things, being easily distracted, and being forgetful. Hyperactivity includes fidgeting, being out of seat, running or climbing excessively, being unable to play quietly, constantly moving, and talking excessively; impulsivity includes calling out answers, having difficulty waiting in turn, and interrupting. The presence of six or more symptoms in each of these two groups is considered a clinical diagnosis. Symptoms must be present before age seven years, impairment must be seen in two or more settings, and evidence of impairment in both social and academic functioning must be documented (American Psychiatric Association, 2000). ADHD symptoms predict a decrease in children's functioning in all areas of their environment, including learning problems and difficulty in relationships with family members, teachers, and peers (Barkley, 1998). Such problems often are correlated with low self-esteem and low self-efficacy which are further predictive of poor school outcomes (Dulcan et al., 1997).

ADHD is a common childhood disorder that results in major public health costs. Public school expenditures for children diagnosed with ADHD have averaged between \$3.5–4 billion annually (National Institutes of Health, 2000). Society generally shares in this burden because these children consume a disproportionate share of resources in the health care system, schools, social services, and the criminal justice system. Manuzza, Klein, Bessler, Malloy, and LaPaluda (1998) found that children with ADHD were at a significantly higher risk for antisocial disorders in adulthood. Likewise, children with ADHD are also at higher risk for substance use and dependence in adolescence and adulthood (Flory & Lynam, 2003; Manuzza et al., 1998; Molina, Smith, & Pelham, 1999). A national survey revealed that students with ADHD were more likely to receive special services than their non-ADHD special education peers (Schnoes, Reid, Wagner, & Marder, 2006). In addition, families of children with ADHD can experience a financial burden when their health insurance does not cover treatment.

The identification of children with ADHD remains challenging. However, multiple tools are available to assist in the diagnosis of ADHD. Parent, teacher and self-report instruments as well as structured interviews exist. An accurate assessment in different environments and from differing perspectives is essential for an accurate diagnosis and for proper treatment. It must be kept in mind that parents and teachers do not always agree. Low correlations between their reports can be partially accounted for by memory of the event, subjectivity, and individual interpretation of behaviors.

Once a child is diagnosed, parents can be confused about the treatment choices because recommendations vary considerably. Treatments for the disorder include medication, behavioral interventions, or a combination of the two (multimodal). Between 76% and 99% of children diagnosed with ADHD are medicated with stimulants or with the nonstimulant atomoxetine. The most commonly used stimulants are methylphenidate (in both oral and transdermal routes), a mixture of amphetamines called Adderall, and dextroamphetamine (Dexedrine).

The functional and interpersonal behavior of many children with ADHD is impaired in multiple settings, and medications can dramatically decrease problem behaviors in many of these children. In general, their activity level is reduced, attention is improved and impulsivity may be lessened. In contrast to their peers without a diagnosis of ADHD, however, troublesome behaviors still remain high (National Institutes of Health, 2000).

Behavioral management techniques designed to decrease the frequency and severity of such troublesome behaviors have been taught to both parents and/or teachers. These techniques have been tested in controlled classrooms, psychoeducational groups and specialized summer camps. Such techniques are derived from behavior modification, social skills training, parent and teacher training and support groups (Pelham & Hoza, 1996). For treatments to be most

effective, they need to be implemented in multiple settings, including the home, school and community (Pelham et al., 2000). Gaining consistency among multiple providers can be difficult.

Although medication has been shown to be the most effective single modality in reducing symptoms and behaviors associated with ADHD, children who receive multimodal treatment can achieve equal efficacy with lower doses of medication (MTA Group, 1999). Multimodal treatment involves both medication as well as behavioral interventions, which include behavior modification and social skills training in multiple settings such as the home, school and social environments. Each treatment modality has its advantages and limitations. Adherence to treatments by parents and children is difficult. Behavioral interventions are time-consuming and require considerable efforts on the part of both parents and teachers in order to see improved behaviors in the child.

1.2. Temperament

Temperament is defined as a behavioral style that individuals consistently exhibit in reaction to their environments (Buss & Plomin, 1984; Chess & Thomas, 1984; Rothbart & Bates, 1998). It encompasses the affective, activational, and attentional sectors within personality and acts as a screen through which children view and interact with their environment. Temperament is evident early in life, relatively stable across time and situations, biologically driven, and genetically linked.

Two complimentary perspectives of child temperament are particularly relevant when exploring the similarities and differences of the construct with ADHD. From a behavioral perspective, McClowry (1998) defined school-age temperament as inborn dispositions that influence reactions to situations, especially those involving change or stress. She identified four dimensions of school-age temperament (McClowry, 1995): Negative reactivity (intensity and frequency with which the child expresses negative affect), task persistence (persistence or attention span), activity (motor behavior), and approach/withdrawal (initial response to new situations). These four domains, or close equivalents, are supported by other studies of children (Ahadi & Rothbart, 1994; Presley & Martin, 1994; Sanson, Smart, Prior, Oberklaid, & Pedlow, 1994).

Based on combinations of dimensions, McClowry (2002) also identified temperament typologies. Fourteen percent of children in her study of 883 participants had a “high maintenance” temperament profile. High maintenance children were high in activity and in negative reactivity and low in task persistence. This typology mirrors the symptoms of ADHD. This profile was developed by second order principal factor analysis with varimax rotation of the temperament dimensions from the School-Age Temperament Inventory. Dimension scores were divided by thirds to determine if they were high, medium or low. The dimensions of this profile are illustrated in a scoring sheet for temperament profiles presented in Appendix A.

Emphasizing psycho-neurobiological components, Rothbart and her colleagues have studied variability in arousability and distress and its relationship to overstimulation, activity, and attention (e.g., Rothbart, Ellis, & Posner, 2004). Rothbart and her colleagues purport that attention has both reactive and self-regulative aspects. The development of attentional focusing is linked to a child’s ability to sustain attention over an extended period. With age and experience, children develop increased capacity for effortful control (Rothbart & Bates, 1998).

Although Rothbart (Derryberry & Rothbart, 2001; Rothbart & Derryberry, 1981) and McClowry (2003) emphasize different facets of temperament in their definitions and measurement, both perspectives can be subsumed under the general heading of self-regulation. Self-regulation is the ability to accomplish goals by self-moderating emotional, attentional, and behavioral responses to events (Rothbart et al., 2004). Children who are low in self-regulation demonstrate difficulties in paying attention at school, organizing tasks, making and retaining friends, moderating emotional displays, and controlling impulsive behaviors (Clark, Prior, & Kinsella, 2002; Miller, Gouley, Seifer, Dickstein, & Shields 2004; Murphy, Shepard, Eisenberg, & Fabes, 2004; Raver, Blackburn, Bancroft, & Torp, 1999). These same behaviors and developmental outcomes are regarded as symptoms of ADHD but can also be viewed as the effects of behavior at the extreme end of normal child temperament.

1.3. The relationship between ADHD and temperament

Despite the theoretical overlap between the constructs of ADHD and of temperament, only two studies have examined their empirical relationship (Bussing, Gary, & Mason, 2003; McIntosh & Cole-Love, 1996). McIntosh and Cole-Love (1996) found that parents and teachers rated the temperaments of ADHD-classified and “normal” children

differently. These researchers studied 70 male children, 35 with ADHD and 35 without the disorder, ranging from 5 to 8 years old. Participants, predominantly Anglo-American middle-class families in the Midwest US, were rated by both parents and teachers on the Temperament Assessment Battery for Children. McIntosh and Cole-Love concluded that children diagnosed with ADHD exhibited temperaments high in activity, high in distractibility, and low in persistence. Those without a diagnosis of ADHD were rated by their parents and teachers to be lower in activity, distractibility and higher in task persistence.

Bussing et al. (2003) studied the temperaments of 200 eight- to ten-year old male and female ($n=52.5\%$) children who screened positive on the Diagnostic Interview Schedule for Children (DISC) for the ADHD-combined subtype based on parent reports. The children who screened positive for ADHD-combined subtype also self-reported low in task orientation and high in activity as measured on the Dimensions of Temperament Survey (DOTS; Lerner, Palermo, Spiro, & Nesselrode, 1982). Children with the combined subtype ADHD scored significantly higher on the activity level-general dimension ($p<.05$) and significantly lower on task orientation ($p<.01$) than did children in the non-ADHD group.

Lemery, Essex, and Smider's (2002), longitudinal study of 451 children examined item overlap between the dimensions of temperament on the Child Behavior Questionnaire and Preschool Behavior Questionnaire and the symptoms of ADHD on the MacArthur Health and Behavior Questionnaire (HBQ; Ablow et al., 1999). To assess ADHD, the researchers used the behavior problem composite for Attention Deficit (inattention and impulsivity subscales). When both empirical and conceptual confounded items were removed, moderate associations (.44 to .59) remained between the temperament dimensions of activity level, attentional focusing and inhibitory control and ADHD symptoms of inattention and impulsivity.

1.4. The present study

The results from Bussing et al. (2003) and McIntosh and Cole-Love (1996) provide some empirical support for a relationship between the constructs of ADHD and child temperament. Questions remain regarding the distinctions between temperament and a diagnosis of ADHD, the strengths of the associations, and the implications for prevention and treatment. In the present study, the following research questions were asked: (1) What are the associations between the temperament dimensions of negative reactivity, task persistence, activity, attentional control, impulsivity and inhibitory control and the ADHD symptoms of hyperactivity, impulsivity, and inattention in school-age children? (2) Is the temperament of school-age children who screen positively for ADHD significantly different from those who do not? (3) Are school-age children who screen positively for ADHD disproportionately overrepresented on the high maintenance temperament profile?

2. Method

2.1. Participants

The convenience sample included 55 six- to eleven-year old children with a mean age of 8.71 ($SD=1.67$) years. Thirty two of the children were referrals to a developmental neurology clinic for symptoms associated with ADHD. A comparison group of 23 same-age children were recruited from a pediatric clinic associated with the same hospital. These children were seen at the time of their normal well child visits.

Descriptive characteristics for the two samples are shown in Table 1. As can be seen in Table 1, the majority of the participants (78.2%) were Anglo-American. The sample also included some African-American, Hispanic-American, and Asian-American children. There was no difference in children's ages for the ADHD group ($M=8.59$, $SD=1.68$) versus the comparison group ($M=8.87$, $SD=1.66$), $t(53)=.60$, $p=.55$. As expected based on national norms, the ADHD group had significantly more males than the comparison group $\chi^2(1, N=55)=5.43$, $p=.02$ (see Table 1).

Family composition did not differ significantly for the two groups. The parent respondents, all of whom were English speaking, included 53 mothers and 2 fathers, ranging in age from 31 to 52 years, with an average age of 40.38 ($SD=4.62$) years. Most of the informants (83.6%) were married ($n=46$), 7.3% were divorced ($n=4$), 7.3% were separated ($n=4$) and 1.8% were single, never married ($n=1$). Parental education varied within groups. Many of the parents (41.8%) were college graduates ($n=23$), 25.5% held graduate degrees ($n=14$), 12.7% attended some college or had specialized job training ($n=7$), 18.2% were high school graduates ($n=10$), and 1.8% had graduate equivalent degrees ($n=1$).

Table 1
Descriptive characteristics of the two samples of participants

Characteristic	Comparison group	ADHD group
<i>Children's age</i>		
Mean	8.87 years	8.59 years
Range	6–11 years	6–11 years
Standard deviation	1.66	1.68
<i>Children's sex</i>		
Female	53% (<i>n</i> =12)	22% (<i>n</i> =7)
Male	48% (<i>n</i> =11)	78% (<i>n</i> =25)
<i>Children's ethnicity</i>		
Anglo-American	82.6% (<i>n</i> =19)	75.0% (<i>n</i> =24)
African-American	13.0% (<i>n</i> =3)	18.8% (<i>n</i> =6)
Hispanic-American	4.3% (<i>n</i> =1)	3.1% (<i>n</i> =1)
Asian-American	(<i>n</i> =0)	3.1% (<i>n</i> =1)

At the time of data collection, none of the children in the comparison group and 63% of those (*n*=20) in the ADHD group were being medicated for ADHD. An additional 28% (*n*=9) of children in the ADHD group were on a “drug holiday.” The remaining 9% (*n*=3) were previously medicated for ADHD for less than two months or had their medication changed within the last two months due to lack of efficacy in controlling problem behaviors. None of the children in the ADHD group had reported co-occurring psychiatric disorders. Three of the children from the comparison sample screened positive for ADHD and were therefore included in the ADHD sample for data analysis.

Parent informants were recruited by the clinic staff and from signs posted in hallways at both the neurology and pediatric clinics. Those who agreed to participate signed consent forms, were interviewed and completed questionnaires. To reimburse them for their time, each participant dyad received a twenty dollar movie theater gift card.

2.2. Measures

2.2.1. ADHD

ADHD was assessed with three instruments: The Revised Conners Parent Rating Scale Questionnaire, Short Form; the ADHD parent interview module from the Diagnostic Interview for Children; and the Strengths and Weaknesses of ADHD – Symptoms and Normal-Behaviors Rating Scale. The Revised Conners Parent Rating Scale Questionnaire, Short Form (CPRS-R:S; Conners, Sitarenios, Parker, & Epstein, 1998) is a 27-item 4-point Likert-type scale (0 = “never,” 1 = “occasionally,” 2 = “often,” and 3 = “very often”) that takes about 10 min to complete and yields 4 mutually exclusive scale scores defined by factor analysis: The cognitive problems/inattention scale (6 items; examples include: “Difficulty doing or completing homework,” “Has trouble concentration in class.”); the hyperactivity scale (6 items; examples include: “Is always on the go or acts as if driven by a motor,” “Hard to control while in malls or while grocery shopping.”); and the ADHD index (12 items; examples include: “Inattentive, easily distracted,” “Short attention span”) were used in this study. Conners et al. (1998) report that alphas range between .86 and .94; and that six-week test–retest correlations were between .72 and .85. In the present study, Cronbach’s alphas ranged from .88 to .96.

The ADHD parent interview module from the Diagnostic Interview for Children (DISC) was developed through epidemiological studies based on the DSM (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). Reliability and validity were assessed using a sample of 247 parent and child dyads. Reliability of the symptom and criterion scales was assessed using interclass correlation coefficients, reported as .84 for the symptom counts and .77 for the criterion counts of the ADHD module. Test–retest reliability was reported as a kappa statistic of .79. The questions used in the interview are highly structured closed-ended questions that screen for frequency, duration and intensity of symptoms for diagnostic symptoms. The child is rated as either positive or negative for a diagnosis of ADHD (Shaffer et al., 2000).

The Strengths and Weaknesses of ADHD – Symptoms and Normal-Behaviors Rating Scale (SWAN; Swanson et al., unpublished manuscript) is an 18-item measure based on the DSM-IV diagnostic criteria for ADHD. It relies on a 7-point Likert scale (3 = “far below,” 2 = “below,” 1 = “slightly below,” 0 = “average,” –1 = “slightly above,” –2 = “above,”

Table 2

Correlations among temperament variables and domains of ADHD symptoms for the total sample ($N=55$)

Temperament variables	Domain of ADHD Symptoms			Domain of ADHD Symptoms		
	Conners H/I	Conners Inattention	Conners ADHD	Swan H/I	Swan Inattentive	Swan Combined
Negative reactivity	.68**	.54**	.61**	.55**	.47**	.52**
Task persistence	-.77**	-.92**	-.91**	-.77**	-.81**	-.82**
Activity	.82**	.60**	.67**	.66**	.51**	.60**
Attentional focusing	-.67**	-.83**	-.82**	-.67**	-.75**	-.73**
Impulsivity	.75**	.62**	.67**	.59**	.68**	.65**
Inhibitory control	-.78**	-.72**	-.79**	-.81**	-.79**	.82*

Note: Conners = The revised Conners Parent Rating Scale. Swan = The Strengths and Weaknesses of ADHD Symptoms and Normal-Behaviors Rating Scale. H/I denotes hyperactivity/impulsivity.

* $p < .05$ (2-tailed). ** $p < .01$ (2-tailed).

–3 = “far above”) to identify inattention (9 items) and hyperactivity/impulsivity (9 items). An example of an item from the inattention scale is “Listens when spoken to directly.” This scale was developed to help decrease over-diagnosis of the children with ADHD (Swanson et al., unpublished manuscript). Cronbach’s alphas were .97 on the inattention scale and .98 on the hyperactivity/impulsivity scale for children in the present study.

2.2.2. Temperament

Child temperament was assessed using two tools, the School-Age Temperament Inventory (SATI) and the Children’s Behavior Questionnaire (CBQ). The SATI is a 38-item 5-point Likert-type (1 = “never,” 2 = “rarely,” 3 = “half of the time,” 4 = “frequently,” 5 = “always”) parent-report instrument that measures four dimensions of temperament (negative reactivity, activity, approach/withdrawal and task persistence). The three dimensions that comprise the high maintenance profile were used in this study: Negative reactivity (12 items: “Gets upset when he/she can’t find something”); activity (6 items: “Runs when entering or leaving the house”); task persistence (11 items: “Does not complete homework unless reminders are given”). The SATI items were drawn from maternal reports of 883 children from 4 to 12 years of age with an average age of 9.31 ($SD=1.58$) years. Fifty one percent of the children were male (McClowry, 2002). Cronbach’s alphas ranged from .80 to .90 and correlations between mother and father reports ranged from .51 to .68. Test–retest correlations after four to six months were between .80 and .89 (McClowry, 1995). In the present study, Cronbach’s alphas were between .90 and .97.

The CBQ is a 7-point Likert-type instrument consisting of 191 items that assess 15 psychobiological dimensions of child temperament. The scales that measure the executive attentional system, necessary for self-regulation, were used in the present study and include attentional focusing (13 items: “Has trouble concentrating when listening to a story”), impulsivity (13 items: “Usually rushed into an activity without thinking about it”), and inhibitory control (14 items: “Can lower his/her voice when asked to do so”). Parents rate their child on a 7-point Likert-type scale (1 = “extremely untrue of your child”; 7 = “extremely true of your child”). The CBQ was standardized using a sample of parents of 262 three to seven year old children in the Northwest region of the US (Rothbart, Ahadi, Hershey, & Fisher, 2001). Cronbach’s alphas on the three scales were reported as .74, .78, and .74 respectively (Rothbart et al., 2001). Cronbach’s alphas in the present study ranged from .78 to .87.

3. Results

3.1. Validity of group classifications

All of the children from the neurology clinic screened positive on the DISC for ADHD. Nineteen percent ($n=6$) were identified as inattentive, 3% ($n=1$) were classified as hyperactive/impulsive, and 78% ($n=25$) were identified as combined. One child (4.3%) in the comparison sample was identified as ADHD, hyperactive/impulsive and two children (8.7%) were identified as ADHD-combined subtype. The three children who screened positive on the DISC for ADHD from the comparison sample were included in the analysis with the ADHD group.

3.2. Relationship between temperament dimensions and ADHD symptoms

Pearson product moment correlations were used to explore the first research question regarding the relationship between the temperament dimensions (activity, negative reactivity, task persistence, attentional focusing, impulsivity, and inhibitory control) and the variables of ADHD (inattention, hyperactivity, and combined). As shown in Table 2, significant correlations, ranging from $-.47$ to $.92$, were found between the temperament dimensions and the ADHD symptoms, all in the expected direction. The lowest correlations, which were still often moderate in size (range = $-.47$ – $.68$), were between negative reactivity on the SATI and the ADHD scales. The highest correlations (range = $-.77$ to $-.92$), were between task persistence on the SATI and the ADHD scales.

3.3. Temperament differences between ADHD and comparison group and normative samples of children

The second research question focused on whether the temperaments of children who screen positively for ADHD were significantly different from those in the normative samples on the SATI and on the CBQ. The children in the normative samples include children whose temperaments range from low to high on all of the dimensions of temperament. It was assumed that the children from the ADHD sample in this study would be more extreme than the normative data, and the children in the comparison sample in this study would be similar to the normative data. Therefore, the temperament dimensions of negative reactivity, task persistence, activity, attentional focusing, impulsivity, and inhibitory control from both the ADHD sample and the comparison group were compared by one-sample *t*-tests to normative data on the SATI and the CBQ. Since doing so involved three comparison groups, a Bonferroni correction ($.05/3$) was used and the alpha level was set at $.017$ for significance. The same temperament dimensions were also compared between the ADHD and non-ADHD groups using an independent sample *t*-test.

Mean (and *SD*) SATI scale scores (activity, negative reactivity, task persistence) are presented in Table 3 for the normative sample, for the ADHD sample, and for the comparison (non-ADHD) sample of the present study. As the upper row of Table 3 shows, the ADHD group SATI scores for activity were higher than the scores for the normative group reported by McClowry (2002), $t(34)=5.19$, $p=.001$, and were also higher than the means for the non-ADHD comparison group included in the present study, $t(54)=3.84$, $p=.001$. With respect to negative reactivity, the ADHD group scores were significantly higher than the scores reported for the normative sample, $t(34)=4.77$, $p<.001$, and for the comparison group, $t(54)=5.49$, $p<.001$. (see middle row of Table 3). The ADHD group means were significantly lower in task persistence than the normative sample means, $t(34)=18.73$, $p=.001$, as well as in the comparison sample, $t(54)=12.240$, $p=.001$ (see lowest row of Table 3).

Unlike the ADHD children who were higher in activity than the normative sample, the comparison group children were significantly lower in activity than the children in the normative sample, $t(19)=3.20$, $p=.005$ (upper row of Table 3). The non-ADHD group children of the present study scored significantly lower than the normative sample children for negative reactivity, $t(19)=3.48$, $p=.003$ (see middle row of Table 3). The non-ADHD children of the present study also scored significantly higher in task persistence, $t(19)=3.28$, $p=.004$, than the normative sample (see lower row of Table 3).

The data from this study were also compared to the standardized norms on the CBQ. Mean (and *SD*) CBQ scale scores (impulsivity, attentional focusing, inhibitory control) are presented in Table 4 for the normative sample, for the ADHD sample, and comparison (non-ADHD) sample of the present study. The children who screened positive for ADHD were significantly higher in impulsivity than the normative sample, $t(34)=3.33$, $p=.002$ (see upper row of Table 4). The ADHD sample means were significantly lower in attentional focusing (Table 4 middle row) and lower in inhibitory control (lower row, Table 4) than the normative sample means, $t(34)=5.72$ and 14.71 , respectively, $ps=.001$.

Table 3
Mean (and *SD*) SATI scale scores for the normative sample, ADHD sample, and comparison (non-ADHD) sample

SATI scale	Normative ($n=883$)	Sample ADHD ($n=35$)	Non-ADHD ($n=20$)
Activity	2.71 (.81)	3.48 (.87)	2.28 (.65)
Negative reactivity	3.09 (.76)	3.61 (.64)	2.63 (.59)
Task persistence	3.50 (.78)	2.08 (.45)	3.85 (.48)

Note. ADHD > normative for activity and negative reactivity and ADHD < normative for task persistence ($ps<.001$). Non-ADHD < normative for activity ($p=.005$) and negative reactivity ($p=.003$) and non-ADHD > normative for task persistence ($p=.004$). ADHD > non-ADHD for activity and negative reactivity ($p<.001$) and ADHD < non-ADHD for task persistence ($p=.001$).

Table 4

Mean (*SD*) scores on the Children's Behavior Questionnaire (CBQ) for the normative sample, ADHD sample, and non-ADHD sample

CBQ scale	Normative (<i>n</i> =341)	Sample ADHD (<i>n</i> =35)	Non-ADHD (<i>n</i> =20)
Impulsivity	4.53 (.76)	5.06 (.94)	3.59 (.98)
Attentional focusing	4.53 (.67)	3.61 (.96)	5.22 (.73)
Inhibitory control	4.91 (.80)	3.47 (.58)	5.33 (.74)

Note. ADHD > normative for impulsivity ($p = .002$) and ADHD < normative for attentional focusing and inhibitory control ($ps < .001$). Non-ADHD > normative for attentional focusing and non-ADHD < normative for impulsivity ($ps < .001$).

The non-ADHD comparison group children, who did not screen positive for ADHD in the present study, did not differ significantly from the normative sample for inhibitory control, $p > .10$. However, the non-ADHD children of the present study were significantly higher on the attentional focusing dimension than the normative sample, $t(19) = 4.19$, $p = .001$, and were significantly lower in impulsivity than the children in the normative sample, $t(19) = 4.29$, $p = .001$ (see middle and lower rows of Table 4, respectively).

3.4. Proportion of high maintenance children in the ADHD group

One way to identify child temperament is to use typologies that include a combination of dimensions rather than individual dimensions. The high maintenance typology of McClowry (2002) mirrors the symptoms of ADHD. It includes children high in activity and negative reactivity and low in task persistence. To answer the third research question regarding whether children who screen positively for ADHD were disproportionately overrepresented on the high maintenance temperament profile (compared to McClowry's 14% of the 883 children in her heterogeneous sample), a binomial test of chi-square proportion was done. The percentage of high maintenance children found in the ADHD group was 66%, which was significantly higher than the 14% found by McClowry (1998), $\chi^2(2, N=32) = .14$, $p = .001$.

4. Discussion

The purpose of this study was to examine the empirical and theoretical differences and similarities of child temperament and ADHD. The results demonstrate that symptoms of ADHD are highly correlated with dimensions of childhood temperament. All three subtypes of ADHD – hyperactive/impulsive, inattentive, and combined (exhibiting symptoms of both inattention and hyperactivity/impulsivity) – were strongly associated with the temperament dimensions of high negative reactivity, low task persistence, high activity, low attentional focusing, high impulsivity, and low inhibitory control.

The direction and strength of the correlations are supported by the limited number of previous studies that examined ADHD and temperament (Bussing et al., 2003; McIntosh & Cole-Love, 1996). McIntosh and Cole-Love's (1996) study of seventy 5–8 year old male children concluded that the children diagnosed with ADHD exhibited temperaments with high activity levels, high distractibility, and low persistence. Bussing et al. (2003) found that 200 male and female 8–10 year old children at risk for ADHD (based on results from the ADHD module of the DISC) scored high on the temperament dimensions of general activity level and low on task orientation. The findings of the present study are consistent with these prior results despite the fact that these prior studies relied on different measures and multiple respondents (parents, teachers and children) to assess temperament.

While consistent with the previous studies, the results from this study are noteworthy for several reasons. For example, the present study utilized two measures of temperament. Whereas the SATI is derived from the theoretical framework of Thomas and Chess, the CBQ is not. Instead Rothbart and Derryberry (1981; Derryberry & Rothbart, 2001) theorized that the attentional system, a prominent part of the psychobiological theory of temperament, explains the interaction between behavioral and biological phenomenon. Attentional reactivity refers to the temperament-based tendency to cognitively and emotionally focus on certain types of environmental inputs, to the exclusion of others. Consequently, while the two previous studies (Bussing et al., 2003; McIntosh & Cole-Love, 1996) examined the relationship between the symptoms of ADHD and the behavioral dimensions of temperament, the present study also found strong associations between the ADHD symptoms and the psychobiological dimensions of temperament.

In his integrative framework, Nigg (2006) asserts that the temperamental traits of poor attention focus, low inhibitory control, high activity level are associated with and often serve as precursors of symptoms of ADHD. The results of the

mean comparisons conducted in the present study support that assertion. However, they also support the assertion that ADHD may be an extreme temperament type. On each dimension of temperament, the children diagnosed with ADHD compared to those from the comparison sample were at the extreme end of the child temperament continuum.

In the comparison sample, the children's temperaments were significantly lower on activity and negative reactivity than the normative group and higher in task persistence. This can be accounted for in two ways: First, three children in the comparison group were identified as ADHD on the DISC. One child (4.3% of the sample) was identified as hyperactive/impulsive and two children (8.7%) were identified as combined subtype. Their scores on the SATI and CBQ were added to the ADHD group when comparing means. This homogeneity in the comparison group could account for the differences in groups on these scores (Pedhazur & Schmelkin, 1991). And secondly, the comparison sample was drawn from families with a high socioeconomic status. Meich, Caspk, Moffitt, Wright, and Silva (1999) found that socioeconomic status was inversely related to self-regulation in children.

Although some theorists maintain that extreme temperament is related to ADHD symptoms (Goldsmith, Lemery, & Essex, 2004), the problem lies in that a definitive cut-off point is nebulous at best. Others argue that the behaviors used to diagnose ADHD are not distinguishable from normal child temperament (Carey, 2002), leading to an over-diagnosis of psychopathology. Kirk (2004) posited that the DSM has a 61% specificity in detecting ADHD, and therefore between 10% and 40% error rate in identifying false positives. The diagnosis of ADHD continues to be controversial and does not take into account the responses of the environment. In the present study three children from the community sample screened positive for ADHD. While their parents acknowledged their behaviors to be challenging, they felt they could manage the children by altering their environments.

A central proposition from temperament theory – goodness-of-fit – is applicable to studying temperament in relation to ADHD and explains the impact of the environment on child behaviors and outcomes. Goodness-of-fit is defined as a match between the temperamental characteristics of the child and the expectations, demands, and opportunities provided by the environment (Chess, 1990). Although the present study did not formally test this theory, it served as the theoretical underpinning of the study. A good fit is predicted to be associated with favorable developmental outcomes. A poor fit, or incompatible relationship between the child's temperament and the environment, puts the child at risk for developing behavioral problems and having poorer developmental outcomes (Chess & Thomas, 1984; Maziade et al., 1990). Goodness-of-fit explains how the environment can foster more adaptive behaviors in children with ADHD. When the environment is altered to match the child's temperament, fewer behavioral problems are expected to develop.

Environmental factors, particularly parenting, contribute to whether a child is treated or even evaluated for ADHD (Barkley, 2000; Robin, 1998). Parents of children with ADHD display more directive and commanding behavior, more disapproval, fewer rewards, and overall more negative disciplinary strategies, resulting in higher degrees of familial disharmony and parenting stress, which in turn lead to poorer long-term behavioral and treatment outcomes for children with ADHD (Hinshaw, Owens, & Wells, 2000; Hoza et al., 2000; Johnston, 1996; Keown & Woodward, 2002). Likewise, children diagnosed with ADHD exhibited more conflictual parental interactions than their non-ADHD counterparts (Barkley, 1998; Conners & Erhardt, 1998; Wells, Epstein, & Hinshaw, 2000). Reductions in parental negative disciplinary strategies, however, were found to be a significant mediator of better developmental outcomes for children with ADHD (Hinshaw et al., 2000).

4.1. Limitations

The strength of the associations between temperament and ADHD symptoms might, at first glance, be attributed to the measurement confounding and attenuation. However, in their study, Lemery et al. (2002) demonstrated that when they removed items that were assessed by content experts as overlapping between temperament and behavior problems, the relationship between temperament and ADHD symptoms remained strong.

A limitation of the present study is its reliance on parental report, raising concern due to potential informant bias. Certainly a more comprehensive view of the child in multiple settings provides a more accurate snapshot of the child's behavior. Teacher reports of ADHD are frequently collected when making a diagnosis of ADHD; unfortunately teacher data were not routinely collected at the clinic that served as the setting for this study. The teacher data that were available consisted of a wide variety of tools and reports, and were not analyzed for this study. Although many children exhibit behaviors that are symptoms of ADHD, a diagnosis is not appropriately applied until the level of problems results in functional deficits in multiple settings. A comprehensive picture of a child incorporates all perspectives, and

while parents have the opportunity to observe their children's typical reactions across a variety of situations, teacher ratings provide a survey of classroom behavior that is not witnessed by parents. The strengths of many home and school observations are their objectivity in that parent and teacher bias would be controlled. Child reports provide yet another facet of information. However, while these types of tools would provide a more wide-ranging illustration of the child, further research is needed to demonstrate validity and reliability of self-report tools to measure both ADHD and temperament in this age group (Conners, 2000; Rothbart & Bates, 1998).

Another limitation of this study was the sample size and cross-sectional design. Longitudinal prospective studies are needed to explore the developmental trajectory of children whose temperaments are at risk for ADHD to assess if with education regarding normal child temperament and parenting implications might result in fewer diagnoses of ADHD in the school-age period.

4.2. Implications

This study revealed that children with ADHD were disproportionately represented as the high maintenance temperament. Among the children that fit the ADHD-combined subtype, 76% matched the high maintenance temperament profile, which is characterized by low task persistence, high negative reactivity and high activity (McClowry, 2002). (See Appendix A for a chart that summarizes scores for each aspect of temperament that correspond to the high maintenance temperament profile). This proportion of children fitting the high maintenance profile is dramatic compared to the 14% that McClowry (2002) found in her community-based sample. Because the present study was cross-sectional rather than longitudinal, it cannot be ascertained why so many of these children had temperaments that were high in negative reactivity. That is, it is not clear whether high negative reactivity has always been part of these children's temperaments or whether they are reacting to the distress that results from their attention problems. One possibility is that children with ADHD, who have more difficulty with sensory processing than their non-ADHD counterparts, may come to experience more negative reactions at home, in school and in the community (Dunn & Bennett, 2002).

4.3. Future directions

Controversy still remains in relation to the potential over-diagnosis of ADHD due to clinicians' failure to recognize normal variations in child temperament. Further studies using larger sample sizes and confirmatory analysis to measure collinearity of criteria for both constructs are needed to provide more specific information concerning the relationship of temperament to ADHD diagnoses. By doing so, the relationship between temperament and ADHD may be further refined and normal behavior may be better distinguished from psychopathology. Greater understanding of the nature and underpinnings of ADHD as well as fewer diagnoses of ADHD may occur. Similarly, clinicians will be more likely to take social context and the child's environment into account when making an assessment of behavior.

Accurate temperament tools are essential for screening and early identification of children at risk for ADHD. Using the data from this study, the sensitivity and specificity (Rao, 2004) of the SATI were examined using the data for those children who were ADHD-combined subtype. This group was selected because they were the largest grouping of children and because it is important to discriminate between the subtypes of ADHD on measurement tools (Baeyens, Roeyers, & Vande Walle, 2006). The SATI has a sensitivity of 74%, a specificity of 93%, and an accuracy of 83% in detecting ADHD-combined subtype. In addition, all of the children who screened positive on the DISC regardless of whether they were inattentive, hyperactive/impulsive, or combined, had temperaments that were low in task persistence. Although the SATI is not recommended as a diagnostic tool, it may be useful for identifying children who may be at risk for developing ADHD.

The findings from this study also have implications for developing and testing the efficacy of temperament-based preventive interventions to reducing ADHD symptoms and co-occurring problems such as conduct disorder and oppositional defiant disorder. The focus of temperament-based intervention is to enhance goodness-of-fit, which is a match between the temperamental characteristics of the child and the expectations, demands, and opportunities provided by the environment (Chess & Thomas, 1984). Goodness-of-fit is associated with positive developmental outcomes. In contrast, an incompatible relationship between the child's temperament and the environment puts the child at risk for developing behavioral problems and attaining poorer developmental outcomes. Although children with extreme temperaments are at risk for developing problems, family functioning can moderate the impact (Hinshaw et al., 2000; Hoza et al., 2000; Maziade et al., 1990; Sanson, Hemphill, & Smart, 2002). The emphasis in a temperament-

based intervention is not to directly change the child, but rather to enhance the child–environment fit by assisting parents and teachers in developing more effective child management strategies (McClowry, 2003; Melvin, 1995).

More useful to practitioners dealing with issues of child development would be longitudinal prevention trials with preschool children whose temperaments put them at risk for a later diagnosis of ADHD. It is important to test whether temperament-based interventions can enhance academic and social competencies and result in fewer diagnoses of ADHD in the school-age years. Although a number of intervention studies have shown effectiveness in reducing the behavioral problems of children with ADHD and reducing their parental distress (Pelham & Waschbusch, 1999; Pelham, Wheeler, & Chronis, 1998), temperament-based prevention programs are just beginning to be tested for their effectiveness. For example, McClowry, Snow, and Tamis-LeMonda (2005) have demonstrated that one temperament-based intervention, INSIGHTS, was efficacious in reducing common behavior problems and had even greater efficacy among those children who had disruptive disorders including ADHD.

The results of this study contribute to the empirical and clinical understanding of ADHD and its relationship to child temperament. The findings also provide further support for considering the child's temperament when deciding upon treatment modalities for school-age children whose extreme temperament places them at risk for developing behavioral problems that may impede their development.

Appendix A

Temperament profile of school-age children

	Negative reactivity	Task persistence	Approach/withdrawal	Activity
	High	High	Withdrawal	High
High	5.00	5.00	5.00	5.00
Medium	3.42	3.91	2.78	3.00
	2.67	3.18	2.22	2.33
Low	1.00	1.00	1.00	1.00
	Low	Low	Approach	Low

Note. A child whose temperament is high in negative reactivity has SATI scores between 3.42 and 5.00; a child who is low in negative reactivity has SATI scores between 2.67 and 1.00.

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